

On the Uniform Dimension System. Is there Necessity for Coulomb?

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Abstract

It is shown that the dimensions of electrical units (ampere, coulomb, etc.) are surplus.

Although electric and magnetic dimensions in systems CGSE and CGSM are expressed in the terms of mass, length, and time units (in SI units ampere was added), they seem strange and bizarre. The exception is a unit of capacity in the system CGSE whose dimension (centimeters) looks convincing. Of course, the dimensions are relative; however, it causes internal resistance, misunderstanding, and difficulties in the perception of the relevant areas of physics, especially for students. Is there need of having electrical values proper, above all ampere (or coulomb)?

Indeed, the basic formulae (the electrical force between the charges and the magnetic force between current-carrying conductors) can be represented with a single dimensional factor of force. Only the number of electric charges z is meaningful for the force of electrical and magnetic interaction. In the Coulomb formula a unit of the charge can be expressed through the electron mass m_e and the classical electron radius r_e . Then Coulomb formula can be obtained as:

$$F_e = (m_e c^2 / r_e) (r_e / r)^2 z_1 z_2, \quad (1)$$

where r , c , z_1 , z_2 - are the distance between the charges, the velocity of light, the number of the electric charges.

Here dimensional coefficient $(m_e c^2) / r_e$ is the centrifugal force that occurs when an electron moves with the light velocity c of the radius r_e . This force is equivalent to the force acting between two elementary charges by the given distance and its numerical value is a very ordinary magnitude equal 29.06 N.

In what units electric charge should be measured? According to John A. Wheeler' idea, the charged microparticles are special points in the three-dimensional spatial surface of our world, connected to each other through "wormholes" - vortical tubes analogous to the lines of current working according to the "input-output" ("source-drain") principle, but in an additional dimension of space. In this model the electric charge is not a special kind of matter: the electric charge only manifests the degree of the non-equilibrium state of physical vacuum; it is

proportional to the momentum of physical vacuum in its motion along the contour of the vortical current tube.

Therefore, the most appropriate is to replace the electric charge in formulae Coulomb and Ampere with the ultimate momentum of the electron $m_e c$. Then all the dimensions of electrical and magnetic values get strikingly simplified and assume sensible and physically obvious form. So, in SI units: current becomes force - [kgm/sec²] or [N], the potential becomes velocity - [m/sec], capacity becomes mass of the electrons accumulated on the plates of the capacitor - [kg], conductivity becomes mass velocity - [kg/sec], inductance becomes the reciprocal value of mass acceleration - [sec²/kg], the magnitude of the solenoid magnetic field becomes the number of turns per unit of solenoid length - [m⁻¹] etc.

The numerical values of the expressions for the electrical and magnetic forces, written in a "Coulombless" form with the charge replaced by the ultimate momentum of the electron, coincide with these values based on standard expressions at the following conditions:

- the value $4\pi\epsilon_0$, which in SI units is $1.11 \cdot 10^{-10}$ farad/metre, is replaced by a new electric constant $\epsilon_0 = m_e / r_e = 3.23 \cdot 10^{-16}$ [kg/m];

- magnetic constant μ_0 , which in SI units is $4\pi \cdot 10^{-7}$ henry/metre, is replaced by a new magnetic constant $\mu_0 = 1/(\epsilon_0 c^2) = 0.0344$ [N⁻¹].

Thus, the electric constant ϵ_0 makes sense the linear density of the vortex tube current, and the magnetic constant μ_0 makes sense the reciprocal value of the interaction force between two elementary charges.

With such mechanistic interpretation Wheeler's scheme numerical values of the electric charge and radiation constants were successfully obtained [1]. In such system value $587 m_e c$ [kgm/sec] is the momentum of the vortical tube current the whole, it numerically corresponds to the electron charge $e_0 = 1.602 \cdot 10^{-19}$ coulomb; at the same time the value $m_e c$ [kgm/sec] corresponds to the "point-like" electron charge. The value of 587 [m/sec] corresponds to one volt in SI units, the value of $4\pi/587^2 = 3.6 \cdot 10^{-5}$ [kg] corresponds to one farad in SI units etc.

Replacing the dimensions and introducing new electromagnetic constants is a purely technical problem, although it is hardly practicable today. It is more important that mechanistic interpretation of the electromagnetic parameters reveals their physical meaning and gives help understanding the nature of phenomena.

For example, the electrical capacity of a sphere of radius $R = 1$ [m] is equal to $3.23 \cdot 10^{-16}$ [kg], which corresponds to $3.5 \cdot 10^{14}$ electrons distributed over its surface and be responsible for the movement of the charges, while the average distance between the charges is $r = \pi(Rr_e)^{1/2} = 1.67 \cdot 10^{-7}$ [m].

The capacitor charge is proportional to the potential, and it is easy to determine the saturation potential φ when the number of electric charges becomes equal with the number of electrons carrying the charges. Since the “point-like” electron cannot carry momentum over $m_e c$, for an only charge: $\varphi = m_e c / m_e = c$ [m/sec] or, in SI units, $c/587 = 511000$ volts. If this potential is exceeded the mentioned magnitude, the charge is spontaneously flowing into the surrounding space.

In these examples (and in others) quite reasonable values have been obtained, which could not be if all above-stated would be wrong. Of course, such associations of electrical and magnetic values with mechanical ones do not yet mean reduction of electromagnetic phenomena to mechanical ones. The question immediately arises, how does the electron be able to carry momentum which exceeds many times your own one? However, this question implicitly always existed because the term "charge" is, in fact, the delicate symbol of not properly understood electricity essence. To some extent, the response has been received in this article, as well as in [1, 2].

References

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2. Belyakov A.V. Macro-analogies and gravitation in the micro-world: further elaboration of Wheeler's model of geometrodynamics. *Progress in Physics*, 2012, v.2, 47–57.